The biomechanical behavior of the optic nerve head and peripapillary scleral connective tissues are currently under study by a growing group of engineers, scientists and clinicians. However, to date, the biomechanics of retinal ganglion cell axon insult and injury within the lamina cribrosa have not been addressed. Recent observations that axoplasmic flow is interrupted at the level of the sclera in mice and rats which have a “cellular” lamina suggest that the laminar connective tissues may not be central to the pathophysiology of axonal distress. This talk will review the principal engineering stresses and strains within the neural and connective tissues of the optic nerve head. This review will emphasize the potential differences between tensile, compressive and shear stresses and strains within the connective tissues and the translaminar hydrostatic pressure gradient generated by the transition from intraocular to cerebral spinal fluid pressures. A fundamental difference in how astrocytes and axons experience connective tissue stress and strain and the translaminar pressure gradient will be proposed. A dynamic between laminar capillary blood flow, the laminar astrocyte footplate and the laminar astrocyte process into the laminar axon bundles will be proposed and contrasted with what is known regarding the same dynamics in the brain. While the existing ocular literature will be discussed, this talk will seek concepts in the optic neuropathy, spinal cord trauma and cardiac ischemia literature that will enhance our understanding of the pathophysiology of laminar axon transport and flow.

CR: C.F. Burgoyne, None.
Role of mitochondria in glaucoma


Mitochondria participate in multiple metabolic functions that include the generation of ATP and can be affected in many ways that include mutations to their mtDNA, chemical or light insults to components of the electron transport chain or lack of substrates such as oxygen.

Retinal ganglion cell axons within the globe are richly provided with many mitochondria required to produce the high energy demand for nerve conduction because of a lack of myelination. Clearly any alteration in the functional status of these ganglion cell axon mitochondria will influence ganglion cell survival. However, little is known of how these mitochondria are affected in human glaucoma. Mitochondria are dynamic organelles and undergo fission and fusion during aging, disease and development. It remains to be established how intra-axonal ganglion cell mitochondria respond in this respect, other than rate of transport, to changes in the quality of blood flow in the optic nerve head that might in glaucoma.

The trigger(s) for ganglion cell apoptosis in glaucoma is/are likely to be multifactorial and the rationale for targeting impaired mitochondrial energy production as a possibility of improving a patient’s quality of life is based on logic. Laboratory studies show that mitochondria are affected to cause apoptosis by raised IOP or by light, both types of insults being more relevant to ganglion cell death in glaucoma than, for example, neuronal apoptosis associated with Parkinson’s disease. Logic suggests that emphasis must be placed in understanding the role of mitochondria in such cases so as to provide potential ways for enhancing mitochondrial function generally as well as assist in the treatment of glaucoma.

CR: N.N. Osborne, None.